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HARVARD UNIVERSITY.



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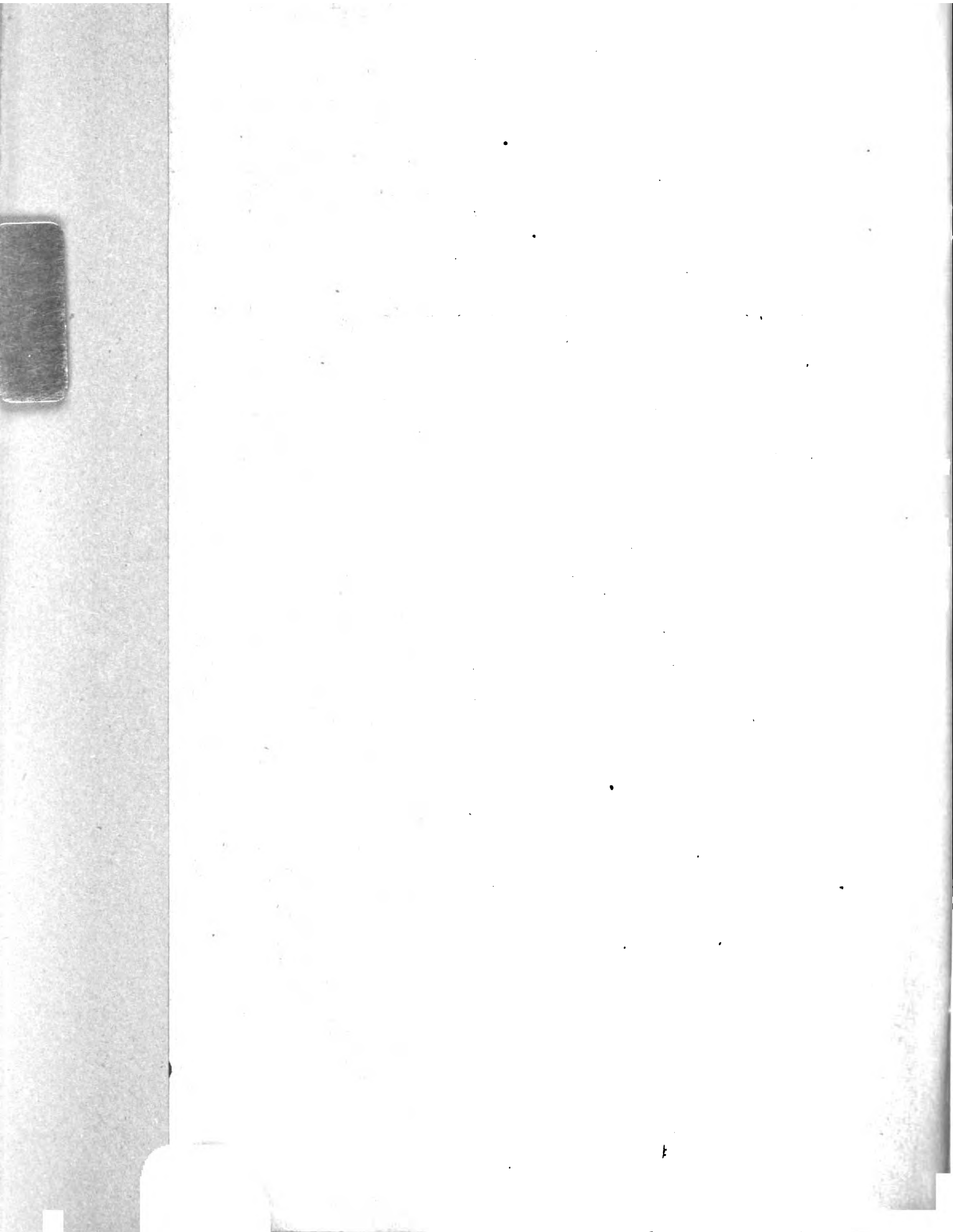
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PHOTOGRAPHIC ILLUSTRATIONS OF THE
MORPHOLOGICAL AND PHYSIOLOGICAL
INDIVIDUALITY OF THE CHROMOSOMES
IN HEMIPTERA, WITH AN ACCOUNT OF
OBSERVATIONS ON THE CHROMOSOMES
IN THE LIVING CELLS

EDMUND B. WILSON



CAMBRIDGE, MASSACHUSETTS
1909



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THIS communication consisted of a demonstration of about eighty lantern-slides prepared from photographs of the chromosomes of the Hemiptera heteroptera, taken by the author. The facts illustrated were as follows:

(1) The size-differences of the chromosomes, and the fact that in the somatic groups the chromosomes may be arranged in pairs according to their size [shown in the spermatogonia and ovarian cells of *Protenor*, *Anasa*, *Largus*, *Pachylis*, and *Euschistus*].

(2) The sexual differences of the chromosome-groups. In those Hemiptera that possess an odd or "accessory" chromosome the female groups have one more chromosome than the male, the additional chromosome being of the same size as the odd chromosome of the male [shown in *Protenor* (δ 13, η 14), *Anasa* (δ 21, η 22), and *Largus cinctus* (δ 11, η 12)]. In those Hemiptera that possess a pair of idiochromosomes in place of a single odd chromosome the number is the same in both sexes, but only the male contains the small idiochromosomes [shown in *Euschistus*].

(3) The odd chromosome varies greatly in size in different genera. In *Protenor*, it is the largest of the group; in *Anasa*, one of the largest three; in *Alydus*, the second smallest. In the growth-period it remains in a compact form, constituting a chromosome-nucleolus of corresponding size [shown in these three forms].

(4) The odd chromosome in Hemiptera divides equally in one of the spermatocyte-divisions but passes undivided to one pole in the other (usually the first, but in *Archimerus* and *Pachylis* the second). Half the spermatid-nuclei therefore receive one more chromosome than the other half [shown in *Protenor*, *Anasa*, *Alydus*, and *Archimerus*]. In *Alydus* and *Protenor* both daughter-groups from the same spindle in late anaphase were shown in polar view, demonstrating six chromosomes at one pole and seven at the other.

(5) The idiochromosomes remain in a condensed form during the growth-period, in some species having the form of compact chromosome-nucleoli, in others that of longitudinally divided rods,

in addition to a plasmosome [shown in *Lygaeus bicrucis*]. They divide as separate univalents in the first spermatocyte-division [shown in *Lygaeus*, *Euschistus*, and *Coenus*], conjugate at the end of this division to form an asymmetrical bivalent [shown in *Euschistus*, *Coenus*, *Lygaeus*], which separates into its two components, the large idiochromosome passing to one pole, the small one to the other [shown in side-view in *Lygaeus*, in polar views of the anaphase daughter-groups from the same spindle in *Euschistus* and *Coenus*].

(6) The "*m-chromosomes*" nearly always form the smallest pair. In *Protenor* or *Leptoglossus* they are hardly smaller than the others; but from this condition a graduated series of successively smaller forms may be traced, through *Anasa*, *Euthoetha*, *Metapodius*, *Alydus*, and *Archimerus*, down to *Pachylis*, where they are extraordinarily minute and no larger than centrioles [this entire series shown]. In all the forms the *m-chromosomes* show the same behavior *whether large or small*, remaining separate as a rule during the growth-period, and only conjugating to form a bivalent in the prophases of the first division [shown in *Leptoglossus*, *Anasa*, *Alydus*, and *Pachylis*]. In some forms they assume a compact nucleolus-like form at a much earlier period than the other chromosomes [shown in *Alydus*].

(7) In two genera, *Banasa* and *Metapodius*, supernumerary chromosomes may be present in certain individuals, though absent in other individuals of the same species. In *Metapodius* from one to five such chromosomes may be found, the number present being constant in a given individual. They show specific peculiarities of size and behavior, as described in a separate communication. The evidence indicates that these chromosomes are supernumerary small idiochromosomes, probably in process of degeneration, and that their presence is due to the occasional failure of the idiochromosome-dyad to divide in a preceding generation [illustrated by views of *Banasa* and *Metapodius*].

Many of these phenomena may be clearly seen under the oil immersion objective in the living cells, or at least in cells of the testis teased apart without other treatment in a normal fluid in which the spermatozoa continue to swim actively. In *Anasa* especially may be clearly seen (1) the number, grouping, and size-relations of the chromosomes in both maturation-divisions; (2) all stages of the passage to one pole in the second division of the undivided odd chromosome and the constriction of the cytoplasm behind it (demonstrating its failure to divide at any period). In the early growth-period the contraction figure of the synaptic-period (synizesis) is clearly visible, proving that it is not an artifact. In the early prophases the characteristic double crosses and other prophase figures are clearly visible in the fresh cells of *Alydus*; and in earlier stages of the same form

both the odd chromosome (chromosome-nucleolus) and the plasmosome may be seen, at first in juxtaposition, later separate. The spindle-fibres are clearly visible as very definite tracts. In the spermatogonia of *Anasa* the centrosome is visible as a minute granule at the tip of the spindle, surrounded by a minute aster. A single fibre extends from its neighborhood to each chromosome. The spindle-fibres often appear as if composed of rows of small granules. In the telophases of the second division the mid-body is visible as a series of refringent granules across the equator of the spindle. All the structures, as seen in the fresh cells, agree very closely with the pictures given by the best sections (strong Fleming's fluid, Bouin's fluid), and prove that the form, grouping, and size-relations of the chromosomes are not materially altered by the technique of fixation and sectioning.

Comparison and analysis of the facts leave no doubt that constant differences of behavior, as well as of size, exist among the individual chromosomes of the group. They lend strong support to the view that the chromosomes, individually considered, are genetically identical in successive cell-generations. To this extent they support the general theory of the "individuality" of the chromosomes, though this name is probably less appropriate than the term "genetic identity" or "genetic continuity."



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